## REMARKS

Claims 1, 2, and 4-27 are pending in the present application. In the final Office Action mailed June 13, 2005, the Examiner rejected claims 1, 2, 11, 12, 17, and 22 under 35 U.S.C. §102(b) by Ojima et al. (USP 4,419,643). The Examiner next rejected claims 4-8 and 13-16 under 35 U.S.C. §103(a) as being unpatentable over Ojima in view of Mumbower (USP 4,845,392). Claims 23-26 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Ojima et al.

## TELEPHONE INTERVIEW SUMMARY

Applicant appreciates the Examiner's willingness to discuss the present case in a telephone interview on September 13, 2005. A summary of the remarks below were presented to the Examiner. At the conclusion of the telephone interview, the Examiner indicated that claims 1 and 11, which call for magnetically repelling a moveable magnetic object when current is induced in a coil, are patentably distinct from the art of record. As acknowledged by the Examiner, Ojima et al. establishes that "in the state in which neither of the operating and release current is applied to an operating and release coil 40, the moving iron core 16 would not be moved by the magnetic energy of the second closed magnetic path because the magnetic flux $\varphi_2$ is small in quantity." Col. 7, ll. 1-10. Accordingly, the Examiner indicated that in response to this Amendment/Response, the finality of the June 13, 2005 Office Action would be withdrawn and that a Notice of Allowance or a new non-final office action would be mailed.

## DETAILED REMARKS IN SUPPORT OF PATENTABILITY OF CLAIMS 1, 2, AND 4-27

Ojima et al. teaches a solenoid whereby forces of *attraction* are exploited to translate an iron core disposed within a coil into contact with a fixed receiver. Ojima et al., as shown in Fig. 3, discloses a solenoid (10) having an annular permanent magnet (14) that is mounted near the end of a movable iron core (16). The solenoid also has a cylindrical member (15) that that defines a volume in which the iron core is to move in response to the inducement of current in a coil (40) wrapped around the cylindrical member. When the movable iron core is

at its original or at-rest position, two separate magnetic gaps are defined. One magnetic gap (18) is defined between the iron core and a fixed receiver (13). The other magnetic gap (44) is defined between "an outer peripheral surface of the moving iron core 16" and "the inner peripheral surface of the opening 41" that is radially defined between yoke proper (11) and the iron core (16). Col. 6, ll. 31-37. These magnetic gaps are exploited to control translation of the iron core toward the fixed receiver.

Specifically, gap (18) is sized to be larger than gap (44) when current is not induced in the coil. In this regard, "when the moving iron core 16 and the fixed receiver 13 are spaced apart, the magnetic fluxes emanating from the permanent magnet 14 set up two closed magnetic paths in the solenoid." Col. 6, ll. 50-53. That is, "a first closed magnetic path is formed via route [magnetic pole N – intermediate portion 11a – gap 44 – cylindrical member 15 - moving iron core 16 – cylindrical member 15 – magnetic yoke 42 – magnetic pole S], and a flux $\varphi_1$ is confined in the first closed magnetic path." Col. 6, ll. 54-59. Ojima et al. further teaches, "A second closed magnetic path is formed via a route [magnetic pole N – intermediate portion 11a – magnetic yoke proper 11 – coupling portion 12 – fixed receiver 13 – gap 18 – moving iron core 16 – cylindrical member 15 – magnetic yoke 42 – magnetic pole S], and a magnetic flux $\varphi_2$ is confined in the second closed magnetic path." Col. 6, ll. 59-65. Ojima et al. continues, "In the second closed magnetic path, as the magnetic resistance in the gap 18 is markedly higher than in gap 44, the magnetic flux $\varphi_2$ confined in the second closed magnetic path is appreciably smaller in quantity than the magnetic flux $\varphi_1$ confined in the first closed magnetic path..." Col. 6, l. 65 – col. 7, l. 2. As a result, "in the state in which neither of the operating and release current is applied to an operating and release coil 40, the moving iron core 16 would not be moved by the magnetic energy of the second closed magnetic path because the magnetic flux $\varphi_2$ is small in quantity." Col. 7, ll. 5-9. In short, the flux in the first closed magnetic path exceeds the flux in the second closed magnetic path and, as a result, the iron core is *attracted* to the permanent magnet via the first closed magnetic path. As set forth below, however, when an operating current is applied to the coil, the flux in the second closed magnetic path exceeds the flux of the first closed magnetic path and, as a result, the permanent magnet *attracts* the iron core via the second closed magnetic path.

Specifically, when an operating current is applied to the operating and release coil, the direction of the magnetic flux in the core produced by the coil coincides with that of the flux $\varphi_2$ from the permanent magnet. As a result of the application of the operating current, a third and a fourth closed magnetic path are created within the solenoid. *See* col. 7, ll. 19-30. The fluxes associated with the third and fourth closed magnetic paths together with the flux of the second closed magnetic path exist along the path of the iron core. *See* col. 7, ll. 31-35. As a result of these magnetic fluxes (the fluxes from the second, third, and fourth closed magnetic paths), "the moving iron core 16 is subjected to a force which moves it towards the fixed receiver 13." Col. 7, ll. 35-37. This is a result of the flux of the first closed magnetic path and the flux of the third closed magnetic path being in opposite directions in gap. *See* col. 7, ll. 36-37. As such, "when the flux $\varphi_3$ (of the third closed magnetic path) becomes larger than the flux $\varphi_1$, the flux $\varphi_1$ is forced to take the second closed magnetic path." Col. 7, ll. 39-41, parentheses added. The moving iron core is thus attracted toward the fixed receiver "by the magnetic energy of the second, third and fourth closed magnetic paths". Col. 7, ll. 45-46. In short, the iron core moves toward the permanent magnet as a result of the *attraction* therebetween, but moves toward the permanent magnet along the second, third and fourth closed magnetic paths. While this results in the iron core moving away from the permanent magnet within the body of the cylindrical member, the iron core is not magnetically repelled by the permanent magnet – it is *attracted* by it.

This is particularly illustrated in Fig. 4 which illustrates translation of the iron core toward the fixed receiver. As shown, the second, third, and fourth closed magnetic paths include the fixed receiver. As such, when the when the flux of the third closed magnetic path exceeds that of the first closed magnetic path, which does not include the fixed receiver, the collective flux of the second, third, and fourth paths is sufficient to overcome the magnetic resistance of gap and, as a result, the iron core moves toward the permanent magnet along the second, third, and fourth closed magnetic paths, but such movement is inhibited by the fixed receiver. Thus, the permanent magnet *attracts* the iron core via the second, third, and fourth flux paths. Or, as explicitly stated by Ojima et al., "an operating current is applied to the operating and release coil 40 so that the direction of the magnetic flux in the core 16 produced by the coil 40 may *coincide* with that of the flux $\varphi_2$ from the magnet 14." Col. 7, ll. 13-16, emphasis added. This coincidence illustrates an *attraction* force between the iron core

and the permanent magnet when an operating current is induced in the coil, not a repellant force.

In contrast, claims 1 and 11 call for a permanent magnet that magnetically attracts a movable magnetic object or armature when a coil is de-energized and magnetically repels the object or armature when the coil is energized. As set forth above, Ojima et al. neither teaches nor suggests controlling movement of a movable object in the manner called for in claims 1 and 11. Specifically, Ojima et al. fails to teach or suggest movement of a movable object using both attraction and repellant magnetic forces. Accordingly, it is believed that claims 1 and 11, as well as those depending therefrom, are patentably distinct from the art of record.

Ojima et al. also teaches an annual non-magnetic spacer that is situated between an iron core and a permanent magnet; however, the spacer is not positioned between the core and the magnet in a path in which the core is designed to move. That is, the cited reference teaches a non-magnetic spacer that extends circumferentially around the path in which core is designed to move, but is not *in* the path, as presently claimed. In other words, the spacer taught by Ojima et al. cannot limit linear movement of the iron core, whereas the claimed non-magnetic spacer can given its position *in* the path in which the claimed plunger is configured translate. Accordingly, it is believed that claim 22 calls for subject matter that is patentably distinct from that taught and/or suggested by Ojima et al.

Claim 23 calls for a spacer is disposed between the permanent magnet and the armature along the direction of linear movement. Claim 23 also calls for the permanent magnet to be positioned in the direction of linear movement and that the armature moves within the bobbin in the direction of linear movement. As set forth above, the non-magnetic spacer disclosed by Ojima et al. is not in the direction of the linear movement of the iron core. That is, Ojima et al. teaches an annular spacer that is positioned orthogonal to the direction of linear movement of the iron core. In short, Ojima et al. neither teaches nor suggests a permanent magnet, armature, and spacer that are all positioned in a common direction. As such, it is believed that claims 23-27 are patentably distinct from that taught and/or suggested by Ojima et al.

Therefore, in light of at least the foregoing, Applicant respectfully believes that the present application is in condition for allowance. As a result, Applicant respectfully requests timely issuance of a Notice of Allowance for claims 1, 2, and 4-27.

Applicant appreciates the Examiner's consideration of these Remarks and cordially invites the Examiner to call the undersigned, should the Examiner consider any matters unresolved.

Respectfully submitted,

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